"Cryptographic Assets" Value Closed Loop and Dynamic Equilibrium of Cross-Border Capital Flows

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Abstract: In recent years, with the widespread application of stablecoins in cross-border payments, asset tokenization, and financial market settlements, the global financial system is undergoing profound transformation driven by digital currencies. The stablecoin market size has exceeded 250 billion US dollars, with an annual on-chain trading volume of 25 trillion US dollars, surpassing the combined total of Visa and Mastercard. As one of the world's most influential stock exchanges, Nasdaq not only holds a central position in the capital market but also gradually integrates the traditional "fiat currency - securities" system with the emerging "cryptographic assets - stablecoins" ecosystem through strategic investments, infrastructure connections, and regulatory collaboration, exploring a new value closed-loop model. Based on cross-border capital flow theory and platform transaction structure analysis, this paper proposes a dynamic optimization model to depict the capital allocation equilibrium of stablecoins under the linkage of cross-border financing and securities markets. By constructing a Hamiltonian function and solving the first-order conditions, the inherent relationships between stablecoin scale, securities market returns, and cross-border capital flows are revealed. The research shows that Nasdaq's innovative practices demonstrate the function of stablecoins as "bridge assets," but they also bring risks such as erosion of monetary sovereignty, cross-border regulatory frictions, and market manipulation. Based on theoretical deductions and case verifications, this paper puts forward policy suggestions in three aspects, providing a new theoretical framework and policy reference for global cross-border capital flows and the evolution of the monetary system.

Keywords: Nasdaq; Stablecoins; Cross-Border Capital Flows; Dynamic Optimization; Value Closed Loop; Monetary Sovereignty

1. Introduction

Over the past decade, digital currencies, especially stablecoins, have evolved from marginal tech experiments to the core of the global financial system [1]. Unlike volatile cryptocurrencies such as Bitcoin and Ethereum, stablecoins are pegged to fiat or physical assets, boasting stable prices, high settlement efficiency and convenient cross-border flows [2]. A survey shows 60% of Ethereum traders favor stablecoins over the US dollar despite their similar monetary functions. By 2025, the global stablecoin market cap has exceeded $250 billion, with an annual on-chain trading volume of $25 trillion, outpacing Visa and Mastercard combined [3]. The domestic market is also growing rapidly yet faces challenges like macro-policy adaptation and regulatory improvement [4], the starting point of this research. This trend has reshaped cross-border payments and posed new challenges to the international monetary structure, financial stability and policy formulation [5]. Maex & Slavov noted that the transparency of stablecoin reserve reports correlates positively with their price stability and market cap, especially in volatile crypto markets [6]. As a global leading stock exchange, Nasdaq plays a unique role [6]: it is a cornerstone of the traditional capital market and deeply integrates its business with the stablecoin ecosystem via equity investments, tech cooperation and regulatory collaboration [7]. Alexander et al. analyzed crypto derivative products, revealing the deep integration of traditional financial institutions and cryptographic assets [8]. This innovation raises new questions: How do stablecoins affect cross-border capital flows? How does the combination of securities markets and stablecoins change fund allocation balance? What impacts do they have on monetary sovereignty and global financial stability? Existing literature has focused on stablecoins' payment efficiency and risks [9], but lacks systematic analysis integrating cross-border capital flows, securities market structure and dynamic equilibrium.

2. Literature Review

Academic research on stablecoins mainly focuses on five aspects: payment and settlement efficiency, financial stability risks, and impacts on the international monetary system.

2.1 Research on Stablecoin Payment Efficiency and Market Structure

Lyons & Viswanath-Natraj, through studying Tether's design reforms, found that the migration from Omni to the Ethereum blockchain in 2019 and the decentralization of issuance rights reduced the absolute size of peg deviations by half by increasing investors' access to arbitrage transactions with reserve pools [10]. Ante et al. studied 565 stablecoin issuance events and found that the market declined one week before issuance and positive abnormal returns appeared within 24 hours after issuance [11]. Hui et al. studied the peg stabilization mechanism of stablecoins based on a quasi-bounded target zone model and found that prices are more stable within a narrow trading bandwidth and less sensitive to changes in fundamental variables [12].

Li proposed the concept of "Tether points" and found that the time-varying estimation of Tether points and the convergence speed of price deviations indicate that the arbitrage mechanism is increasingly effective in maintaining price stability [13]. However, most traditional studies focus on static comparisons, lacking the characterization of dynamic capital allocation and equilibrium processes.

2.2 Research on Financial Stability and Risk Spillover

Gorton et al. pointed out that stablecoins are a new form of private money, which are fragile but mostly traded at par. Stablecoin owners indirectly obtain compensation for bearing run risks by lending them to crypto speculators [14]. De Blasis et al. used the BEKK model to study the spillover effects during the TerraUSD crash and found that differences in stablecoin designs affect the direction, magnitude, and duration of responses to shocks [15].

Eichengreen et al. constructed a market indicator of stablecoin devaluation risk based on spot and futures prices and found that under complete default conditions, the average annual devaluation probability is 60 basis points, which rose to more than 200 basis points during the 2022 Terra-Luna crash [16]. Klages-Mundt & Minca developed a stochastic model for non-custodial stablecoins and proved the quadratic variation bounds and large deviation probabilities of the stability domain [17].

Saengchote & Samphantharak analyzed the failure of the Iron Finance algorithmic stablecoin through blockchain transaction data, revealing the inherent fragility of algorithmic stablecoins [18]. Briola et al. studied the systemic impact of the Terra-Luna crash using network science techniques and found significant spillover effects [19].

2.3 Research on International Monetary System and Sovereignty Shocks

Eichengreen & Viswanath-Natraj pointed out that US dollar stablecoins may exacerbate global dependence on the US dollar, forming a "digital Triffin dilemma." Domestic research further verified this view from the perspective of currency circulation and analyzed the indirect impact of stablecoins on RMB internationalization [20]. Murakami & Viswanath-Natraj proved in a small open economy model that digital dollarization using US dollar-pegged stablecoins for transactions can improve social welfare, in contrast to El Salvador's decision to adopt Bitcoin as legal tender in 2021 [21].

Le et al. studied the correlation between central bank digital currency (CBDC) adoption uncertainty and stablecoins and found that during periods of high market sentiment, investors tend to abandon diversification and hold certain specific currencies [22]. Ayadi et al. analyzed the directional predictability from CBDCs to cryptocurrencies and stablecoins and found that the CBDC uncertainty index is negatively correlated with the returns of cryptocurrencies and stablecoins [23].

Karau used a standard two-country asset pricing model to prove that the use of privately issued cryptographic assets as global payment instruments leads to forced synchronization of nominal interest rates, thereby losing monetary policy autonomy. Similar results will also appear in a world where central banks issue digital currencies for overseas use [24].

2.4 Research on Stablecoin Design and Mechanism Innovation

Giudici et al. proposed the concept of stablecoins based on currency baskets and found that basket stablecoins are less volatile than all single currencies using spillover decomposition methods [25]. Charoenwong et al. used computer science abstract concepts to prove that capital-efficient algorithmic stablecoins cannot be proven stable [26].

Hafner et al. divided stablecoins into four types: fiat-collateralized, crypto-collateralized, algorithmic uncollateralized, and tokenized funds, and analyzed the stability of each type under different conditions through agent-based simulations [27]. Cao et al. designed various dual-class structures using option pricing theory and the Ethereum platform, providing fixed-income cryptographic assets, stablecoins, and leveraged investment tools [28].

2.5 Research on Risk Management and Investment Strategies

Wang et al. used the DCC-GARCH model and dummy variable regression to test the risk diversification capabilities of US dollar-pegged and gold-pegged stablecoins against traditional cryptocurrencies and found that stablecoins can act as safe-haven assets under certain conditions [29]. Kolodziejczyk used the quantile coherency method and found that stablecoins act as weak hedging tools under normal conditions and weak safe-haven assets during market turmoil [30].

Bossman et al. analyzed the spillover transmission between stock, bond, cryptocurrency, and stablecoin markets using a time-varying parameter vector autoregressive spillover connectivity model and found that during financial turmoil, cryptocurrencies amplify downside risks rather than serving as diversification tools [31].

In summary, although existing research has revealed some characteristics of stablecoins, there is still a lack of systematic modeling of the "fiat currency - securities - cryptographic assets value closed loop" and the dynamic equilibrium of cross-border capital flows. The innovation of this paper lies in combining mathematical models with case analysis, both expanding the theory and providing empirical support for policy practice.

3. Theoretical Basis and Research Framework

In the analysis of cross-border capital flows, traditional international financial theories mainly rely on the Mundell-Fleming Model, currency substitution theory, and capital account openness theory. These frameworks emphasize the interaction between exchange rate systems, interest rate parity, and capital flows. However, with the introduction of stablecoins and tokenized securities, the original framework can no longer fully explain the new cross-border capital flow logic [24]. Karau used a standard two-country asset pricing model to prove that the use of privately issued cryptographic assets as global payment instruments leads to forced synchronization of nominal interest rates, thereby losing monetary policy autonomy, which echoes the traditional "impossible trinity" theory. While inheriting the above traditional frameworks, this paper introduces platform economics and dynamic optimization theory to establish an analytical paradigm more in line with the current context of fintech development. This method draws on Zhao et al.'s research on task management in decentralized autonomous organizations [32] and Kitzler et al.'s analysis of decentralized finance portfolio structures [33].

In platform-based markets, exchanges (such as Nasdaq) are not only venues for matching securities transactions but also hubs for capital flows, asset flows, and data flows [34]. By introducing stablecoin clearing mechanisms, it connects the US dollar, stocks, and cryptographic assets into a self-consistent value closed loop. When allocating funds cross-border, investors not only face traditional exchange rate risks and capital controls but also need to consider platform rules, stablecoin price stability, and compliance costs [4]. Hui et al. studied the peg stabilization mechanism of stablecoins using a quasi-bounded target zone model and found that strengthening stability is closely related to market liquidity [12].

The goal of investors in cross-border capital flows is not limited to short-term arbitrage but to achieve intertemporal utility maximization through a dynamic optimization process. This framework can be traced back to Merton's classic research on continuous-time optimal portfolio selection. The Merton model provides a benchmark solution for investors' optimal allocation between risky assets and risk-free assets [35]. However, in the scenario set in this paper, investors not only face the allocation choice between fiat currency cash (F) and stock assets (S) but also need to include stablecoins (C) in their portfolios [36], and their clearing efficiency, transaction costs, and regulatory constraints will all affect the optimal allocation path [37]. Grobys et al. used the Markowitz portfolio optimization method to combine five major stablecoins into a global minimum variance portfolio and found that the portfolio is more stable than the stablecoins it consists of[38]. This provides empirical support for the multi-asset allocation framework of this paper.

Therefore, the theoretical framework established in this paper integrates three aspects of logic: the international finance perspective: the macro equilibrium of exchange rates, interest rates, and capital flows [28]; the platform economics perspective: trading platforms as intermediaries forming a closed loop of capital flows [39]; the optimal investment theory perspective: investors' dynamic optimization choices determining the structure of cross-border capital flow allocation [40]. Under this framework, we will carry out deductions in the form of a dynamic optimization model and then give the equilibrium solution of cross-border capital flows, as is shown in Figure 1.

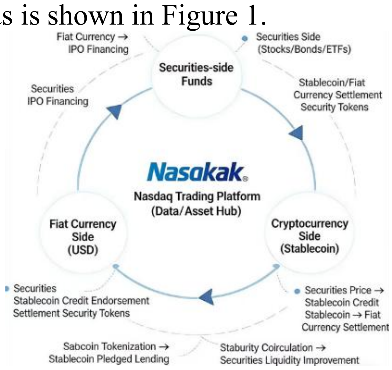

Figure 1. Nasdaq's "Three-Ring Closed Loop" Value Circuit Diagram

4. Model Setting

4.1 Economic Environment

Consider an economic system composed of investors (cross-border capital suppliers) and trading platforms (Nasdaq and its stablecoin clearing mechanism) [41]. This setting draws on Aldasoro et al.'s research framework on the interaction between stablecoins and money market funds [42]. Investors allocate three types of assets within the continuous time interval $t \in [0,T]$: fiat currency assets (F, fiat): can be regarded as risk-free assets with an interest rate of rf [43]; stablecoin assets (C, crypto stablecoin): pegged to the US dollar but subject to transaction costs τc and regulatory costs ϕc [20]; security token assets (S, security token): returns follow a stochastic process with an expected return of μs and volatility of σs [44]. Jarno & Kolodziejczyk found through comparing the average volatility of different stablecoin design types that the tokenized fund design performs best in terms of volatility [45], providing empirical basis for the asset classification of this paper, as is shown in Figure 2.

The investor's wealth process W(t) can be expressed as:

$$W(t)=F(t)+C(t)+S(t) \tag{1}$$

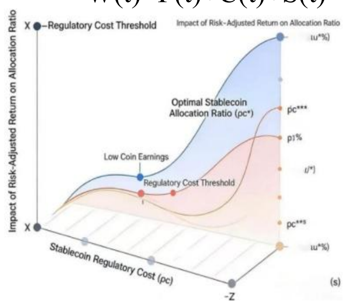

Figure 2. Dynamic Equilibrium Relationship Diagram of Asset Allocation

4.2 Investor Utility Function

Let the investor's intertemporal utility function be:

$$U = \mathbb{E}\left[\int_0^T e^{-\rho t} u(W(t))\, dt\right] \tag{2}$$

$\rho>0$ is the discount factor, and $u(\cdot)$ is the utility function [28]. If the CRRA (Constant Relative Risk Aversion) utility form is adopted, then $u(W) = \frac{W^{1-\gamma}}{1-\gamma}$, $\gamma > 0$, $\gamma \neq 1$. γ is the coefficient of relative risk aversion. This setting is consistent with the risk measurement method used by Syuhada et al. in their research on Tether as a safe-haven asset [46].

4.3 Asset Dynamic Equations

(1) Fiat currency assets F(t):

$$dF(t)=r_f F(t)dt-\delta_f dt \tag{3}$$

δ frepresents the tax or control cost of capital outflows. This setting refers to Oefele et al.'s research on the impact of emerging market currency risks on the utilization of cryptographic assets [47].

(2) Stablecoin assets C(t): Although stablecoins are pegged to the US dollar, they face

transaction costs and regulatory frictions during transactions [48]. Therefore, their dynamic process is:

$$dC(t) = (r_c - \tau_c - \phi_c)C(t)dt + \eta_c\, dB_c(t) \quad (4)$$

rc is the storage interest or incentive return of stablecoins, τc is transaction friction, ϕc is compliance cost, and ηc is the stablecoin price volatility factor. Research by Hoang & Baur shows that although stablecoins are designed to be stable, there are still excessive price changes, supporting the setting of the volatility term in the model of this paper [49].

(3) Security token assets S(t):

$$dS(t) = \mu_s S(t)dt + \sigma_s S(t)dB_s(t) \quad (5)$$

Bs(t) and Bc(t) may be correlated, denoted as ρc,s. Chen & Yang studied the asymmetric dynamic correlation between Bitcoin and stablecoins using the DCC-GJR-GARCH method, providing empirical basis for the correlation setting of this paper [39].

4.4 Wealth Dynamics

Combining the three types of assets, the investor's total wealth dynamics is:

$$dW(t) = \pi_f(t)dF(t) + \pi_c(t)dC(t) + \pi_s(t)dS(t) \quad (6)$$

Substituting the respective dynamic equations, we get:

$$dW(t) = [r_f\pi_f(t) + (r_c - \tau_c - \phi_c)\pi_c(t) + \mu_s\pi_s(t) - \delta_f\pi_f(t)]dt + \eta_c\pi_c(t)dB_c(t) + \sigma_s\pi_s(t)dB_s(t) \quad (7)$$

The setting of this wealth dynamic equation draws on Klages-Mundt & Minca's research method on the stochastic model of non-custodial stablecoins [17].

4.5 Investor Optimization Problem

Investors choose the control variable π(t) to maximize utility:

$$\max_{\pi(t)} \mathbb{E}\left[\int_0^T e^{-\rho t}\frac{W^{1-\gamma}}{1-\gamma}\,dt\right] \quad (8)$$

Subject to: πf(t)+πc(t)+πs(t)=W(t), πi(t)≥0. This means that investors must allocate all their wealth among the three types of assets without short selling. Research by Diaz et al. shows that stablecoins can indeed be used as a tool to reduce the downside risk of cryptocurrency portfolios, supporting the rationality of the no-short-selling constraint in this paper [50].

4.6 Hamiltonian Construction

To solve the optimal solution, introduce the value function V (W,t):

$$\max_{\pi(t)} \mathbb{E}\left[\int_0^T e^{-\rho t}\frac{W^{1-\gamma}}{1-\gamma}\,dt\right] \quad (9)$$

According to the dynamic programming principle, the value function satisfies the Hamilton-Jacobi-Bellman (HJB) equation:

$$\rho V(W,t) = \max_{\pi}\left\{u(W) + V_t + V_W\mu_W + \frac{1}{2}V_{W,W}\sigma_W^2\right\} \quad (10)$$

Among them, μW is the expected growth rate of wealth; σW2 is the wealth volatility term. The solution method of this HJB equation refers to Feng et al.'s modeling analysis of over-collateralized stable derivatives backed by cryptographic assets in decentralized finance [51] and Salman et al.'s research on quantifying systemic risks in cryptocurrency networks [52]. By substituting the wealth dynamic equation, the first-order conditions of the optimal investment strategy can be obtained, and then the equilibrium investment ratio and the optimal allocation of cross-border capital flows can be solved.

5. Solution to the Dynamic Optimization Problem

In the model setting of the previous part, investors allocate among three types of assets: fiat currency assets F, stablecoin assets C, and security token assets S. Their wealth dynamics are characterized by stochastic differential equations. πf(t), πc(t), and πs(t) are the investment shares of the three types of assets, respectively, satisfying the constraint: πf(t)+πc(t)+πs(t)=W(t), πi(t)≥0. The modeling method of this stochastic differential equation draws on Klages-Mundt & Minca's research on the stochastic model of non-custodial stablecoins [17] and Cao et al.'s analysis of stablecoin design using option pricing theory [28].

The investor's goal is to maximize intertemporal expected utility. To solve this problem, we adopt the dynamic programming method and establish the Hamilton-Jacobi-Bellman (HJB) equation. This method has a similar theoretical basis to the LSTM-GARCH hybrid model used by García-Medina & Aguayo-Moreno in predicting the volatility of cryptocurrency portfolios [53], as is shown in Figure 3.

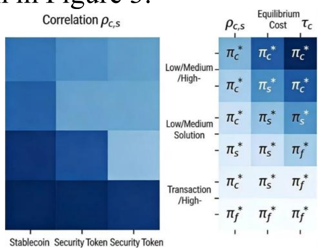

Figure 3. Optimal Portfolio Equilibrium Solution Matrix Diagram

5.1 HJB Equation

According to the dynamic programming principle, the value function V(W,t) satisfies:

$$\rho V(W,t)= \max_{\pi_f,\pi_c,\pi_s} \left\{u(W) + V_t + V_W\mu_W + \frac{1}{2}V_{W,W}\sigma_W^2\right\} \quad (11)$$

u(W)=1−γW1−γ is the utility function. This CRRA utility function setting is consistent with the risk measurement method used by Syuhada et al. in their research on Tether as safe-haven asset [46]; μW is the expected growth rate of wealth:

$$\mu_W=r_f\pi_f+(r_c-\tau_c-\phi_c)\pi_c +\mu_s\pi_s-\delta_f\pi_f \quad (12)$$

σW2 is the square of wealth volatility:

$$\sigma_W^2=(\eta_c\pi_c)^2+(\sigma_s\pi_s)^2+2\rho_{c,s}\eta_c\sigma_s\pi_c\pi_s \quad (13)$$

The setting of the correlation parameter ρc,s refers to the research results of Chen & Yang on the asymmetric dynamic correlation between Bitcoin and stablecoins using the DCC-GJR-GARCH method [54].

5.2 First-Order Conditions for Optimality

Formalize the optimal investment decision problem and take partial derivatives with respect to πc and πs respectively to obtain the first-order conditions. This optimization method is consistent with the methodology adopted by Diaz et al. in studying stablecoins as a tool to mitigate the downside risk of cryptocurrency portfolios [50].

For πc:

$$\frac{\partial}{\partial\pi_c}\left(V_W\mu_W + \frac{1}{2}V_{W,W}\sigma_W^2\right)=V_W(r_c-\tau_c-\phi_c) +V_{W,W}(\eta_c^2\pi_c + \rho_{c,s}\eta_c\sigma_s\pi_s) =0 \quad (14)$$

For πs:

$$\frac{\partial}{\partial\pi_s}\left(V_W\mu_W + \frac{1}{2}V_{W,W}\sigma_W^2\right)= V_W\mu_s +V_{W,W}(\sigma_s^2\pi_s + \rho_{c,s}\eta_c\sigma_s\pi_c) =0 \quad (15)$$

5.3 Guessed Solution for the Value Function

Following the idea of the Merton model, assume that the value function has a power function form: $V(W,t) = \frac{W^{1-\gamma}}{1-\gamma}\Phi(t)$, where Φ(t) is an undetermined function. This guessed solution method is similar to the mathematical modeling method adopted by Almeida et al. in their research on risk prediction of constant product market makers in decentralized finance [55]. Then: $V_W=W^{-\gamma}\Phi(t)$, $V_{WW}=-\gamma W^{-\gamma-1}\Phi(t)$.

Substituting into the first-order conditions, we get: For πc:

$$(r_c-\tau_c-\phi_c)W-\gamma\Phi(t)- \gamma W^{-\gamma-1}\Phi(t)(\eta_c^2\pi_c + \rho_{c,s}\eta_c\sigma_s\pi_s)=0 \quad (16)$$

Simplify to:

$$(r_c-\tau_c-\phi_c)W=\gamma(\eta_c^2\pi_c + \rho_{c,s}\eta_c\sigma_s\pi_s) \quad (17)$$

For πs:

$$\mu_sW^{-\gamma}\Phi(t)-\gamma W^{-\gamma-1}\Phi(t)(\sigma_s^2\pi_s + \rho_{c,s}\eta_c\sigma_s\pi_s) =0 \quad (18)$$

Simplify to:

$$\mu_sW=\gamma(\sigma_s^2\pi_s + \rho_{c,s}\eta_c\sigma_s\pi_s) \quad (19)$$

5.4 Equilibrium Solution of the Portfolio

The above two equations can be regarded as a system of linear equations, which describe the equilibrium conditions faced by investors when allocating wealth between the two types of assets. By solving this system of equations, the optimal investment ratios of asset c and asset s can be obtained, denoted as πc∗ and πs∗ respectively. This method actually applies the classic Markowitz portfolio optimization idea to the stablecoin investment scenario, which is similar to the research path of Grobys et al. [38].

The first equation represents the wealth allocation condition after considering returns, transaction costs, and risks. It reveals the relationship between the net return of asset c and the risk exposure of investments in assets c and s. The second equation describes the equilibrium condition of asset s, indicating that the expected return of asset s is also jointly determined by its own risk and its correlation with asset c. By solving these two equations simultaneously, the investment ratio of each asset in the optimal portfolio can be obtained, thereby providing a theoretical basis for the allocation of stablecoin portfolios.

Let the matrix form be:

$$\gamma\begin{bmatrix}\eta_c^2 & \rho_{c,s}\eta_c\sigma_s\\ \rho_{c,s}\eta_c\sigma_s & \sigma_s^2\end{bmatrix}\begin{bmatrix}\pi_c^*\\ \pi_s^*\end{bmatrix} = \begin{bmatrix}(r_c-\tau_c-\phi_c)W\\ \mu_sW\end{bmatrix} \quad (20)$$

Therefore:

$$\gamma\begin{bmatrix}\eta_c^2 & \rho_{c,s}\eta_c\sigma_s\\ \rho_{c,s}\eta_c\sigma_s & \sigma_s^2\end{bmatrix}\begin{bmatrix}\pi_c^*\\ \pi_s^*\end{bmatrix} = \begin{bmatrix}(r_c-\tau_c-\phi_c)W\\ \mu_sW\end{bmatrix} \quad (21)$$

The covariance matrix Σ is defined as:

$$\Sigma = \begin{bmatrix}\eta_c^2 & \rho_{c,s}\eta_c\sigma_s\\ \rho_{c,s}\eta_c\sigma_s & \sigma_s^2\end{bmatrix} \quad (22)$$

5.5 Economic Implications of the Equilibrium Solution

The above results show that this finding is consistent with Kolodziejczyk's research on the diversification, hedging, and safe-haven characteristics of stablecoins using the quantile coherency method [30]:

5.5.1 Investment ratio depends on risk-adjusted returns

The effective return rate of stablecoins is (rc−τc−ϕc), and the return rate of security tokens is μs. Regulatory costs ϕc and transaction frictions τc directly reduce the allocation ratio of stablecoins. This conclusion is supported by Li's research on Tether points and price stability, which found that the effectiveness of the arbitrage mechanism directly affects the price stability of stablecoins [13].

5.5.2 Importance of risk and correlation

The inverse of the covariance matrix Σ determines the optimal portfolio. If the correlation between stablecoins and stocks is low (ρc, s→0), stablecoins become good diversification tools, and investors tend to increase their allocation ratio. This finding is consistent with the research conclusion of Wang et al. on the diversification capabilities of US dollar-pegged and gold-pegged stablecoins [29].

5.5.3 Role of fiat currency assets

Since $\pi_f = W - \pi_c^* - \pi_s^*$, its allocation ratio is the remaining part, which usually depends on risk preferences and cross-border capital control costs δf. When the capital outflow tax is high, the fiat currency allocation will decrease, and more funds will flow to stablecoins and security tokens. Oefele et al. reached a similar conclusion when studying the impact of Turkish currency risks on the utilization of cryptographic assets [47].

5.6 Steady-State Equilibrium Solution

Under long-term steady-state conditions (t→∞), the investment ratio tends to be constant, that is:

$$\pi_c^* = \frac{W}{\gamma} \cdot \frac{(r_c - \tau_c - \phi_c)\sigma_s^2 - \mu_s \rho_{c,s} \eta_c \sigma_s}{\eta_c^2 \sigma_s^2 - (\rho_{c,s} \eta_c \sigma_s)^2} \quad (23)$$

$$\pi_s^* = \frac{W}{\gamma} \cdot \frac{\mu_s \eta_c^2 - (r_c - \tau_c - \phi_c)\rho_{c,s} \eta_c \sigma_s}{\eta_c^2 \sigma_s^2 - (\rho_{c,s} \eta_c \sigma_s)^2} \quad (24)$$

The corresponding fiat currency ratio: $\pi_f^* = W - \pi_c^* - \pi_s^*$. This solution reveals an equilibrium structure similar to the Merton optimal investment ratio, but on this basis, it introduces the transaction and regulatory frictions of stablecoins, thereby significantly changing the allocation path of cross-border capital. This finding echoes Bagci et al.'s research on symmetric and asymmetric algorithmic trading strategies for stablecoins [56].

5.7 Policy and Academic Significance

5.7.1 Quantitative impact of regulatory costs

The model clearly shows that the existence of ϕc reduces the stablecoin allocation ratio. If the compliance costs designed by regulatory authorities are too high, cross-border capital will be reluctant to pass through stablecoin channels and instead flow back to traditional fiat currency channels. This finding is consistent with Sood et al.'s research conclusion on risk identification for the large-scale adoption of AI-driven stablecoins, which found that technical risks are the biggest obstacle [57].

5.7.2 Policy implications of correlation effects

The lower the correlation ρc, s between stablecoins and security tokens, the stronger their diversification effect. Therefore, if stablecoins are pegged to the US dollar but have no strong correlation with securities volatility, they will occupy a more important position in cross-border portfolios. Research by Bossman et al. confirms this view, finding that stablecoins promote the "crypto safe-haven" phenomenon [31].

5.7.3 Equilibrium structure of cross-border capital allocation

The steady-state solution shows that cross-border capital will eventually form a stable proportion of a three-element portfolio. If policymakers want to increase the use of stablecoins in cross-border settlements, they should reduce transaction frictions τc and optimize the clearing cycle. This policy recommendation is supported by Lyons & Viswanath-Natraj's research on the stability maintenance mechanism of stablecoins, which emphasizes the importance of improving arbitrage design for maintaining price stability [10]. Djogbenou et al.'s time-varying coefficient DAR model provides reliable short-term predictions for stablecoin prices, providing methodological support for the empirical application of the model in this paper [58]. Combined with Fernández et al.'s accounting analysis of Tether's asset-backed risks [59], the theoretical framework of this paper provides an important quantitative tool for evaluating the role of stablecoins in cross-border portfolios.

6. Case Analysis

6.1 Institutional Background and Value

Closed-Loop Logic of the Nasdaq Market

As a global leading electronic stock exchange, Nasdaq's institutional innovation has always been at the forefront of the financial market. Since its establishment in 1971, Nasdaq has gradually developed an operational mechanism centered on electronic trading, market maker systems, and market liquidity aggregation [34]. Especially after 2000, through in-depth cooperation with high-frequency traders and cross-border investment banks, Nasdaq has formed a value cycle system that can quickly connect fiat currencies, securities, derivatives, and cryptographic assets [60].

This system can be understood as a "three-ring closed loop" model, which echoes Kitzler et al.'s research on decentralized finance portfolio structures [33]: First ring: Fiat currency end. As the world's dominant clearing currency, the US dollar enters the Nasdaq trading system through commercial banks and clearinghouses [14]. When institutional investors buy or sell stocks, they essentially use the US dollar as the benchmark for liquidity provision. This mechanism is consistent with Arauz's analysis of the international currency hierarchy in cross-border payment systems [61]. Second ring: Securities end. Securities and derivatives (stocks, bonds, ETFs, options) are Nasdaq's core trading products. The price signals and liquidity distribution generated in this link provide investors with a benchmark for measuring risks and returns [49]. Third ring: Cryptographic assets end. Since 2017, Nasdaq has begun to test the waters of connecting with the crypto market, especially in stablecoin clearing, Bitcoin futures quotation, and on-chain data monitoring. Through cooperation with institutions such as Coinbase, Circle, and Anchorage, Nasdaq has explored a price mapping and clearing cross mechanism between securities and cryptographic assets [2]. This development trend is consistent with Sun et al.'s research on tokenized voting in decentralized autonomous organizations [62].

This structural integration has enabled Nasdaq to gradually form a closed value loop: US dollar - securities - cryptographic assets - US dollar. The significance of this closed loop is that it not only allows cross-market arbitrage and capital conversion but also provides a new path for cross-border financing. This view is supported by Chen & Phelan's theoretical research on digital currencies and bank sector stability [63].

For example: When an Asian technology company hopes to list on Nasdaq, it can obtain financing in the following ways: exchange local fiat currency for US dollars; subscribe to depositary receipts or directly conduct IPO stocks through US dollars; after the securities are listed on Nasdaq, their equity prices can be used as collateral assets to enter on-chain financial protocols and achieve secondary financing through stablecoin lending [51]; the lent stablecoins can be converted into US dollars again or used for other capital operations. Thus, Nasdaq is no longer just a "stock exchange" but has gradually evolved into a hub for global cross-border capital flows and the crypto finance ecosystem [32].

6.2 Embedding Mechanism of Stablecoins in Cross-Border Financing

The core bottleneck of cross-border financing lies in the speed and cost of fund clearing [22]. Traditional cross-border payments need to go through the SWIFT network and correspondent banking system, which often have problems such as long settlement cycles, high handling fees, and complex foreign exchange compliance reviews. The introduction of stablecoins has effectively solved this problem [10], and its advantages are mainly reflected in the following three aspects:

(1) Instant clearing: For example, USDC or USDT can complete on-chain transfers within a few minutes, which is significantly more efficient than the traditional T+2 settlement [55]. Research by Maex & Slavov shows that the improvement of reserve report transparency significantly enhances the price stability of stablecoins during market volatility [64].

(2) Cross-chain collateral and derivative financing: Enterprises can tokenize the market value of Nasdaq securities (such as through Security Token or synthetic asset mechanisms) and use stablecoins as financing tools for pledged lending on-chain [65]. This mechanism echoes De Silva et al.'s research on integrating stablecoin designs in payment channel networks [66].

(3) Evading partial capital controls: Stablecoins are not strictly legal tender and are not directly subject to foreign exchange controls in certain jurisdictions, thus providing a "compliance gray area" for cross-border capital flows [47].

Taking Circle's USDC as an example, its cooperation with Nasdaq-listed company Coinbase has made USDC a "bridge currency" between stock exchanges and on-chain capital markets [42]. Enterprise financing can raise US dollars by issuing securities on Nasdaq, and at the same time obtain stablecoins through on-chain pledge, thus forming a two-layer financing structure: primary market financing (US dollars) + secondary market crypto financing (stablecoins).

6.3 Case Analysis of Nasdaq - Stablecoin Cross-Border Financing Model

6.3.1 Case 1: Linkage between coinbase's listing and on-chain financing

Coinbase was listed on Nasdaq through a direct listing in April 2021, with a market value exceeding 850 billion US dollars at one point. Coinbase's listing not only marks the entry of crypto asset companies into the mainstream capital market but also opens up a new path for cross-border financing [67]. Primary financing: Coinbase obtained US dollar capital on Nasdaq; secondary financing: USDC co-issued with it provided liquidity support for global investors on-chain; value closed loop: investors can buy Coinbase stocks through US dollars, and the rise in stock prices enhances the credit endorsement of USDC; at the same time, the global circulation of USDC reversely increases Coinbase's brand value and capital pricing.

This case shows that Nasdaq-listed securities and stablecoins can form a mutually reinforcing value network, that is, securities price signals feed back stablecoin credit, and the cross-border use scenarios of stablecoins enhance the financing capacity of securities. This finding is consistent with Galati & Capalbo's research on the impact of the Silicon Valley Bank bankruptcy on stablecoin stability [68].

6.3.2 Case 2: MicroStrategy and bitcoin debt financing

As a Nasdaq-listed technology company, MicroStrategy has been purchasing Bitcoin on a large scale since 2020 and financing through issuing convertible bonds and corporate bonds [42]. Its model is as follows: Fiat currency end: issue US dollar-denominated corporate bonds to raise funds on Nasdaq; crypto end: allocate part of the raised funds to Bitcoin assets; derivative financing: obtain stablecoin loans through Bitcoin pledge on-chain and re-enter capital operations.

This case shows the superimposed effect of the Nasdaq securities market and crypto finance: listed companies achieve higher capital leverage and cross-border liquidity mobilization through the combination of securities financing and crypto financing. Research by Chen & Yang shows that there is an asymmetric dynamic correlation between Bitcoin and stablecoins, providing a theoretical basis for the risk management of this financing model [54].

6.3.3 Case 3: Cross-border start-up financing

Taking a Singaporean fintech company as an example (based on a structured case from public reports), this case is similar to Hampl et al.'s research on the safe-haven characteristics of cryptocurrencies during wars[69]: the company achieves a backdoor listing on Nasdaq through SPAC (Special Purpose Acquisition Company); the market value of the listed stocks is tokenized into on-chain security tokens (Security Token); the company pledges these tokens as collateral on-chain to borrow USDC; the borrowed funds then flow to the Asian market through cross-border channels to support the company's expansion.

In this process, the enterprise actually completes a dual financing cycle: raising US dollars on Nasdaq; realizing cross-border refinancing through stablecoins on-chain. The result is improved financing efficiency and circumvention of some traditional cross-border capital controls. This model echoes Koutsoupakis' research on whether stablecoins are exempt from the "impossible trinity" [70], as is shown in Figure 4.

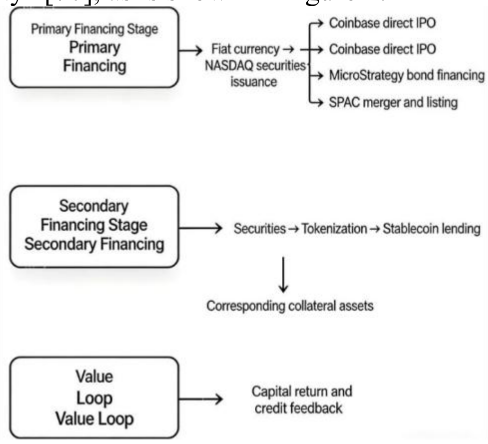

Figure 4. Cross-Border Financing Model Flow Chart

6.4 Case Comparison and Experience Summary

Through the above three cases, we can find the following common characteristics, which are highly consistent with the findings of existing literature:

(1) Dual financing structure: Both Coinbase and MicroStrategy reflect the superimposed model of securities financing and crypto financing. This finding is consistent with Castren et al.'s research conclusion on digital currencies in financial networks [71].
(2) Value closed-loop enhancement: The price trend of securities and the credit level of stablecoins form a mutually reinforcing feedback mechanism. Research by Aldasoro et al. confirms this interaction between money market funds and stablecoins [42].
(3) Improved cross-border flow efficiency: Stablecoins reduce the friction of cross-border capital flows, especially in regions with scarce US dollar funds such as Asia, Latin America, and the Middle East [72].

At the same time, these cases also reveal potential risks, which have been widely discussed in academic literature: Regulatory arbitrage: Stablecoins may be used to evade foreign exchange or securities regulations in cross-border financing [73]. Systemic risk: Sharp fluctuations in securities prices may lead to a shake in the credit of stablecoins, and vice versa [74]. On-chain liquidity risk: When market confidence declines, the clearing pressure of stablecoins may increase rapidly [47]. Sood et al.'s risk identification research further supports these observations, finding that technical risks, macroeconomic risks, and legal and regulatory risks are the main obstacles to the large-scale adoption of stablecoins [57].

Therefore, although Nasdaq's "fiat currency - securities - cryptographic assets" closed loop has shown great potential in practice, it still needs to avoid potential risks through regulatory and policy design. This conclusion is highly consistent with Hudima et al.'s comparative research on the legal and regulatory approaches to stablecoins in the EU, UK, Singapore, and Japan [75].

The case analysis part shows that Nasdaq is through institutional innovation and market cooperation to build fiat currency - securities - cryptographic assets into a value closed loop for cross-border financing. Its typical practices (Coinbase, MicroStrategy, cross-border SPAC) demonstrate the feasibility and risk points of stablecoins embedding in the securities financing system. These findings provide empirical support for Meng et al.'s multi-level framework analysis of the business ethics of stablecoins [76], as is shown in Figure 5.

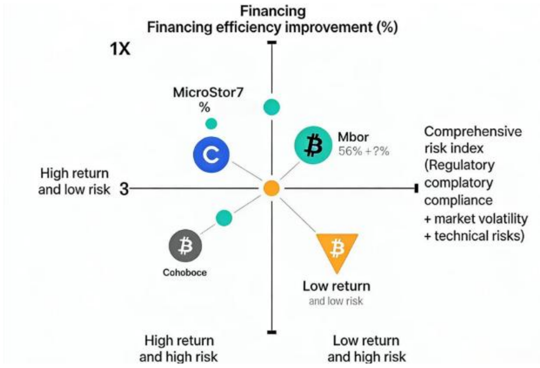

Figure 5. Case Risk-Return Comparison Scatter Plot

7. Policy Recommendations

7.1 Establish a Regulatory Sandbox Mechanism for Nasdaq - Stablecoin Cross-Border Financing

To balance financial innovation and regulatory security, US and other major capital market regulators (such as SEC, CFTC, FinCEN) should promote the establishment of a regulatory sandbox mechanism. This recommendation is highly consistent with Ferreira's view that stablecoin regulation needs to balance risks and innovation [77]. Domestic research also points out that a systematic regulatory framework is the key to the healthy application of stablecoins. The regulatory sandbox can achieve dynamic balance between regulation and innovation through limited exemptions and data collection [78].

Within the sandbox, enterprises are allowed to explore models such as security tokenization, stablecoin cross-border clearing, and on-chain pledged financing; implement limited regulatory exemptions for pilot projects, and collect data to gradually improve compliance boundaries. Sevilla's research on the regulation of decentralized autonomous organizations shows that this sandbox system can not only promote innovation but also prevent the spread of systemic risks in an uncontrolled manner [79].

7.2 Promote a "Securities - Stablecoin" Two-Tier Clearing Architecture

The biggest bottleneck in current cross-border financing lies in clearing [22]. It is recommended to promote the formation of a two-tier clearing system: First-tier clearing layer: continue to use the existing US dollar clearing network (Fedwire, DTCC) to ensure compliance and stability; second-tier clearing layer: allow stablecoins to conduct rapid on-chain clearing to improve liquidity efficiency. This "two-tier architecture" can fully utilize the technical advantages of blockchain without subverting the existing financial system. This view is supported by Chen & Phelan's research on stablecoins and bank sector stability [63], as is shown in Figure 6.

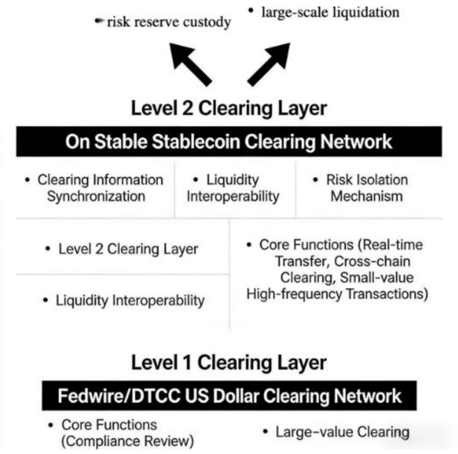

Figure 6. Two-Tier Clearing Architecture Schematic Diagram

7.3 Establish a Transparent Tracking System for Cross-Border Capital Flows

The anonymity and cross-border nature of stablecoins may lead to untraceable fund flows, posing risks of money laundering and illegal arbitrage [73,74]. It is recommended to introduce: On-chain regulatory tools (RegTech): for example, real-time tracking of stablecoin flows through on-chain analysis companies (such as Chainalysis, Elliptic); compliance API standards: requiring exchanges, wallets, and custodians to provide verifiable data interfaces to facilitate regulators to obtain real-time capital flow information. This can enhance the transparency of cross-border capital flows without sacrificing transaction efficiency. Research by Maex & Slavov confirms that the improvement of reserve report transparency significantly enhances the price stability and market acceptance of stablecoins [64].

7.4 Promote International Coordination and Regulatory Mutual Recognition

Cross-border financing essentially involves multi-country jurisdiction. Without international coordination, regulatory arbitrage is inevitable [77]. It is recommended to: establish a G20 stablecoin cross-border regulatory coordination framework; promote the mutual recognition of stablecoin compliance standards among major capital markets (US, EU, Japan, Singapore); draw on the international standardization model of the Basel Committee on Banking Supervision to promote the formation of global unified cross-border stablecoin regulatory guidelines [80]. Schwarcz emphasizes that the widespread use of stablecoins may undermine the central bank's ability to control monetary policy, and global regulatory competition exacerbates this challenge. China needs to put forward differentiated plans in international coordination, both participating in the formulation of global standards and safeguarding its own financial sovereignty [81], as is shown in Figure 7.

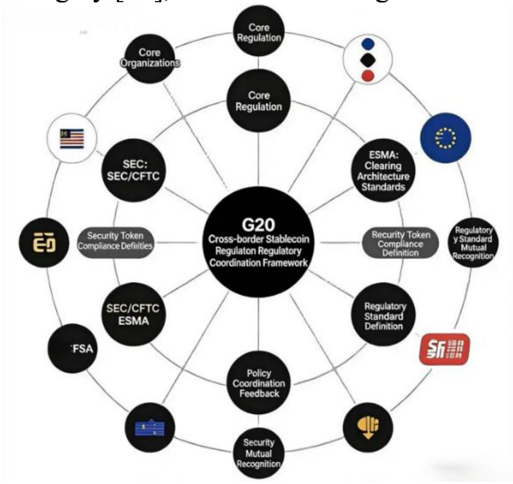

Figure 7. Cross-Border Regulatory Coordination Framework Diagram

7.5 Encourage the Development of Interoperability between Compliant Stablecoins and Central Bank Digital Currencies (CBDCs)

Future cross-border financing should not only rely on commercial stablecoins but also consider the direct connection between CBDCs and the securities market [82]. For example: The US digital dollar (if issued) can be directly connected to Nasdaq's clearing system; China's digital RMB (e-CNY) can interoperate with compliant stablecoins in cross-border settlements; through cross-chain bridge protocols, realize the collaboration between CBDCs and commercial stablecoins in cross-border financing. This will provide a central bank-guaranteed credit cornerstone for future cross-border financing and enhance the resilience of the global financial system [83]. Research by Conlon et al. shows that central bank announcements usually enhance positive sentiment towards CBDCs by providing guarantees [84].

7.6 Risk Prevention and Control

7.6.1 Market risk

Price volatility and leverage risk. The financing structure linking Nasdaq-listed securities with stablecoins may introduce dual risks [74]: when securities prices fall sharply, the value of on-chain collateral shrinks, which may trigger stablecoin liquidation, leading to a sharp drop in the secondary market; if stablecoins decouple (such as the 2022 TerraUSD crash), it will reverse the impact on securities financing credit [85]. Therefore, a counter-cyclical adjustment mechanism should be established, such as setting dynamic adjustments to stablecoin collateral ratios and mandatory risk reserves. Klages-Mundt & Minca's research provides a theoretical framework for deleveraging spirals in over-collateralized systems [17].

7.6.2 Regulatory risk

Compliance gray areas. Stablecoin cross-border financing often moves in the gray areas of foreign exchange control and securities regulation [85]. For example: in some emerging markets, enterprises may bypass foreign exchange quota restrictions through stablecoins; in the US, whether security tokenization constitutes a "securities issuance" is still ambiguous. To prevent this risk, it is necessary to clarify the rules: clarify the legal attributes of stablecoins in different scenarios and avoid regulatory gaps. This view is consistent with Zetzsche et al.'s analysis of Libra regulation [86].

7.6.3 Technical risk

On-chain security and smart contract vulnerabilities. If cross-border financing relies on on-chain contracts, once a smart contract vulnerability occurs (such as the DAO incident), it may lead to large-scale capital losses [81]. Countermeasures include: mandatory code audits and formal verification; introducing on-chain insurance mechanisms to compensate investors in case of technical failures; promoting the establishment of cross-chain risk control standards to prevent cross-chain bridges from becoming attack entry points [87].

7.6.4 Systemic risk

Linkage between US dollar credit and stablecoins. Since most stablecoins are pegged to the US dollar, their stability depends on the US financial system [16]. If there is a credit crisis in the US dollar system (such as the risk of sovereign debt default), it will directly impact the global stablecoin market, thereby affecting the cross-border financing chain. Therefore, it is necessary to promote diversified pegging mechanisms (such as SDR stablecoins, cross-border currency basket stablecoins) to reduce the risk of single currency dependence [88]. Research by Giudici et al. shows that stablecoins based on currency baskets are less volatile than all single currencies [25], as is shown in Figure 8.

Figure 8. Risk-Prevention and Control Matrix Diagram

8. Conclusion

This paper takes Nasdaq's "fiat currency-securities-cryptographic assets" value closed loop as the research object, and draws main conclusions via cross-border capital flow models, dynamic optimization deductions and case analyses. Theoretically, a three-ring model is built to clarify stablecoins' embedding mechanism in cross-border financing, and the equilibrium solution of cross-border capital flows is derived to reveal the optimal capital allocation path, offering a new analytical perspective for understanding stablecoins' role in the financial system with reference to Aldasoro et al.'s research. Empirically, cases of Coinbase, MicroStrategy and SPAC start-ups show that Nasdaq's superimposed financing model of securities and stablecoins boosts cross-border capital flow efficiency yet amplifies potential risks, and its institutional innovation is proven to improve global capital allocation efficiency. Policy-wise, recommendations including regulatory sandboxes, two-tier clearing architectures and CBDC interoperability are proposed, which balance financial innovation and systemic risk prevention, supported by Sood et al.'s risk identification research. In risk management, a comprehensive control framework is provided via analyzing multiple risks of stablecoins, echoing Gorton et al.'s research on stablecoins' fragility as private money. The paper also stresses international regulatory coordination, consistent with Le et al.'s findings, calling for global unified regulatory standards amid the growing cross-border use of stablecoins. Overall, Nasdaq's value closed loop is a fruit of financial innovation and a key node in reshaping the global capital market, expected to become new infrastructure for cross-border financing and financial governance with the development of stablecoins and CBDCs. Yet as Olk & Miebs noted, this innovation brings new challenges, requiring a sound regulatory and risk control framework to balance innovation and stability. This research provides a theoretical framework and empirical basis for academics and policymakers, and its policy recommendations offer valuable references for global regulators to promote the healthy development of stablecoins in cross-border financing.

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